

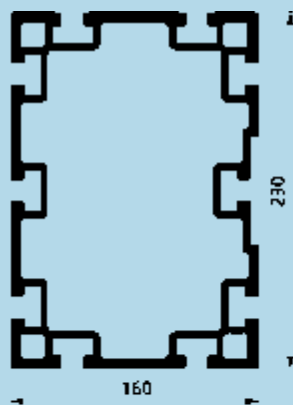


WMH GROUP GERMANY. QUALITÄT.

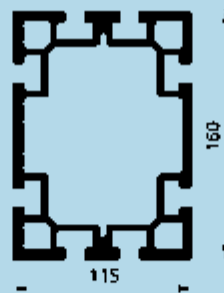
# NTS Beam System

## Profile overview

For detailed dimensions, please see the enclosed 1:1 die drawings.

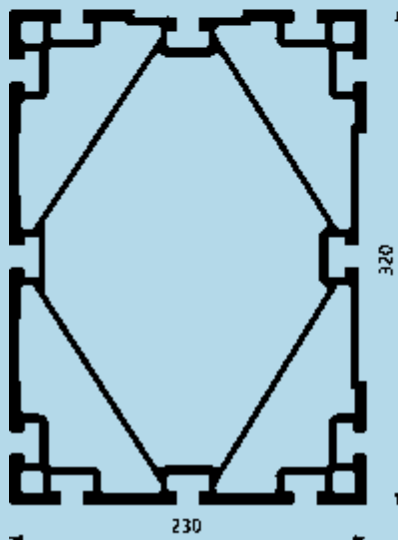
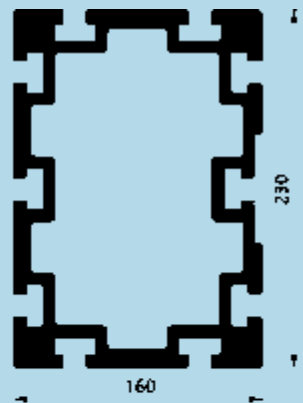


**NTS 23x16 I**  
die No. 41735  
G=19,82 kg/m



**NTS 16x11,5 I**  
die No. 41732  
G=13,53 kg/m

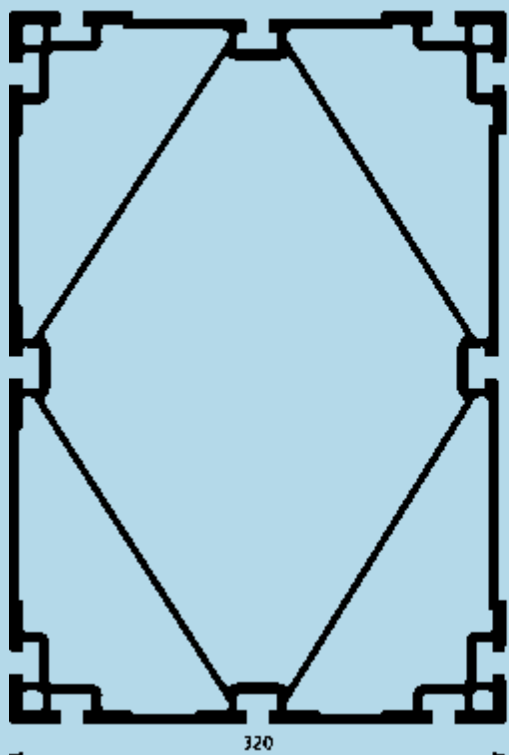
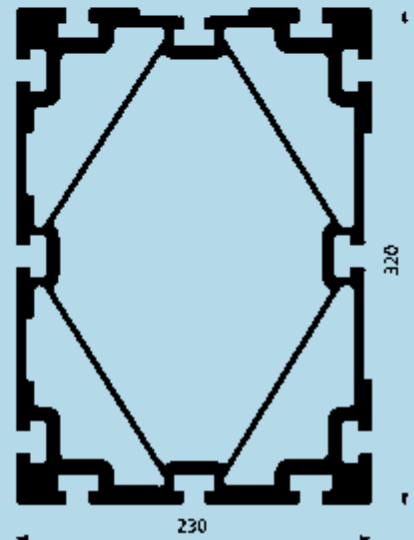
**NTS 23x16 s**  
die No. 41738  
G=29,74 kg/m



**NTS 32x23 I**  
die No. 41741  
G=34,65 kg/m

**T-slots:**  
NTS 16x11,5 I:  
for DIN M10 T-nuts  
NTS 23x16 to 46x32:  
for DIN M12 T-nuts  
Corner spacings of the edge slot axis:  
40 mm

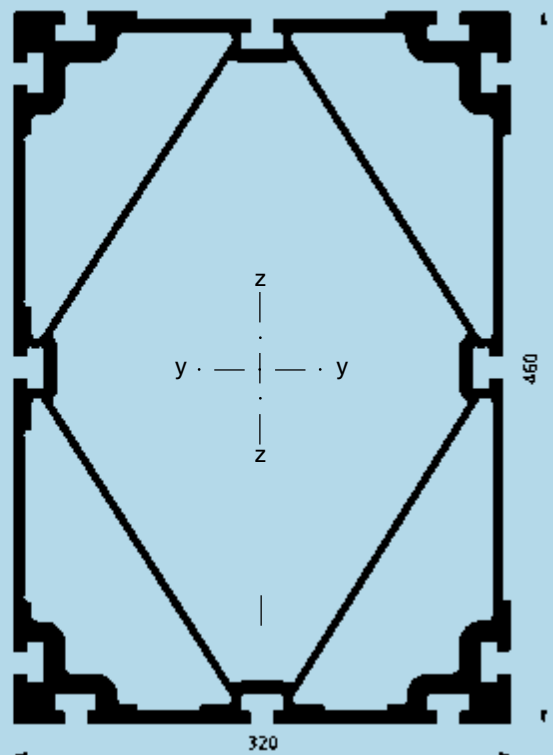
**NTS 32x23 s**  
die No. 41744  
G=46,09 kg/m



**NTS 46x32 I**  
die No. 41747  
G=51,05 kg/m

**Attention:**  
Profiles are not  
symmetrical with the  
exception of  
16x11,5 I

**NTS 46x32 s**  
die No. 41750  
G=66,78 kg/m



## Basic values for verification

### Alloy

AlMgSi0,5 (6060/6063) F22 acc. to DIN 1748.1  
(6063 T6 after the changeover to DIN EN 755-2)  
 $R_m \geq 215 \text{ N/mm}^2$   
 $R_{p0,2} \geq 160 \text{ N/mm}^2$   
 $A_5 \geq 5\% \text{ }^1$   
 $HB \geq 70$

Permissible stresses acc. to DIN 4113:  
(loading case H)  
Tension/compression/bending:

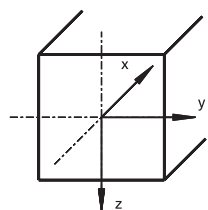
95 N/mm<sup>2</sup>  
 Shear: 55 N/mm<sup>2</sup>  
 Bearing stress for bolts 1: 120 N/mm<sup>2</sup>  
 (clearance of bolts  $\leq 1 \text{ mm}$ )  
 Bearing stress for bolts 2: 145 N/mm<sup>2</sup>  
 (clearance of bolts  $\leq 0,3 \text{ mm}$ )  
 Bearing stress for bolts 3: 125-205 N/mm<sup>2</sup>  
 (prestressed bolts)

### Physical values

Density  $\rho$ : 2,7 g/cm<sup>3</sup>  
 Modulus of elasticity E: 70 000 N/mm<sup>2</sup>  
 Shear modulus G: 27 000 N/mm<sup>2</sup>  
 Poisson's ration  $\nu$ : 0,33  
 Coefficient of thermal expansion  $\alpha$ :  $23,5 \cdot 10^{-6} \text{ 1/K}$   
 Specific heat:  $\approx 0,9 \text{ J/(g K)}$   
 Electrical conductivity: 28-35 m/( $\Omega \text{ mm}^2$ )

### Cross section values<sup>2)</sup>:

Section No.	G	A	I <sub>y</sub>	W <sub>y</sub>	I <sub>z</sub>	W <sub>z</sub>	I <sub>T</sub>	C <sub>M</sub>
NTS ...	[kg/m]	[cm <sup>2</sup> ]	[cm <sup>4</sup> ]	[cm <sup>3</sup> ]	[cm <sup>4</sup> ]	[cm <sup>3</sup> ]	[cm <sup>4</sup> ]	[cm <sup>6</sup> ]
16x11,5 l	13,53	50,12	1649	206	859	149	526	2472
23x16 l	19,82	73,42	5128	446	2716	336	1865	22370
23x16 s	29,74	110,15	7471	650	3847	473	2769	25850
32x23 l	34,65	128,33	17407	1081	9203	792	8091	51800
32x23 s	46,09	170,71	23619	1460	12225	1047	10882	81930
46x32 l	51,05	189,06	53788	2326	27620	1713	32108	275000
46x32 s	66,78	247,32	74147	3191	35526	2195	40706	920200



Calculation programme DUENQ of Messrs. Dlubal (thin-walled sections) was used for the calculation of torsion constants.

The indicated section moduli are minimum values. Since the axes through the centre of gravity almost coincide with the centre lines,  $\max W = \min W = W$  can be used for practical design.

<sup>1)</sup> varying from DIN or EN

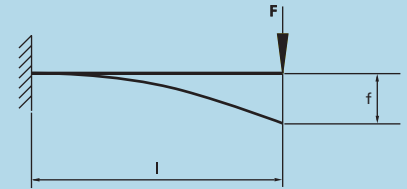
<sup>2)</sup> Orientation of axes in acc. to DIN 1080

## Formulae for design

### Cantilever beam

The easiest way to verify cantilever beams for deflection and twist is to use the formulae:

Deflection:  $f = \frac{F \cdot l^3}{3 \cdot E \cdot I}$



Angle of twist:

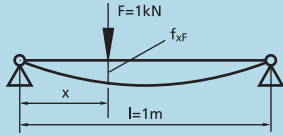
$$\alpha = \frac{M_T \cdot l}{G \cdot I_T} [\text{rad}] = \frac{M_T \cdot l \cdot 180}{G \cdot I_T \cdot \pi} [^\circ]$$



## Beam on two supports

### Deflection under point load

Deflection  $f_{xF}$  of point  $x$  in mm under unit load  $F = 1$  kN (100 kg) at the point  $x$  for a unit span of  $l = 1$  m



Calculation of general cases:

$$f_x = f_{xF} \cdot F \cdot l^3 \text{ [mm]}$$

(with  $F$  in kN,  $l$  in m)

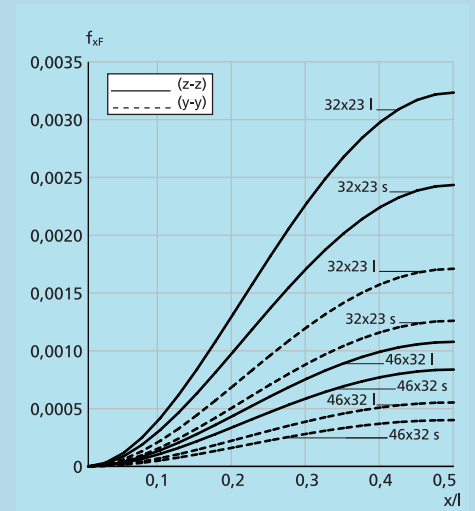
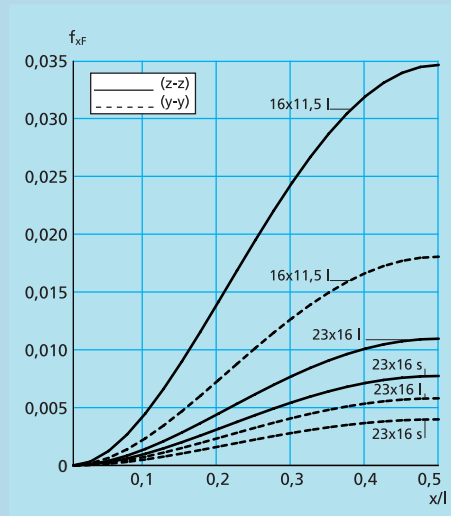
e.g. beam 23x16 I (z-z);

(bending about the weak axis)

$l = 8$  m,  $F = 5$  kN at  $x = 3,2$  m

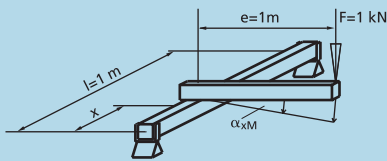
$$\Rightarrow x/l = 0,4 \text{ and } f_{xF} = 0,01$$

$$f_x = 0,01 \cdot 5 \cdot 8^3 = 25,6 \text{ mm}$$



### Twist under torsional moment

Angle of twist  $\alpha_{xM}$  of point  $x$  in [°] under unit torsional moment  $M_T = 1$  kNm at the point  $x$  for a unit span of  $l = 1$  m.



Calculation of general cases:

$$\alpha_x = \alpha_{xM} \cdot M_T \cdot l \text{ [°]} \text{ or } \alpha_x = \alpha_{xM} \cdot F \cdot e \cdot l$$

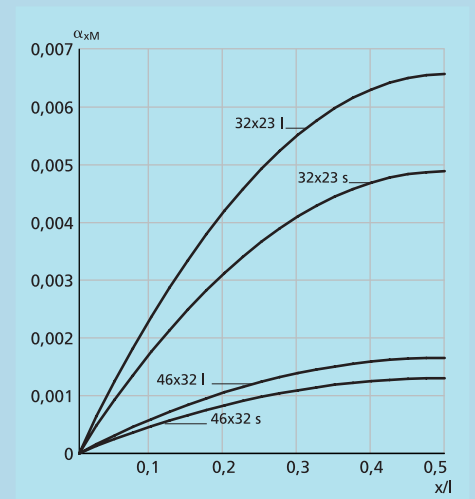
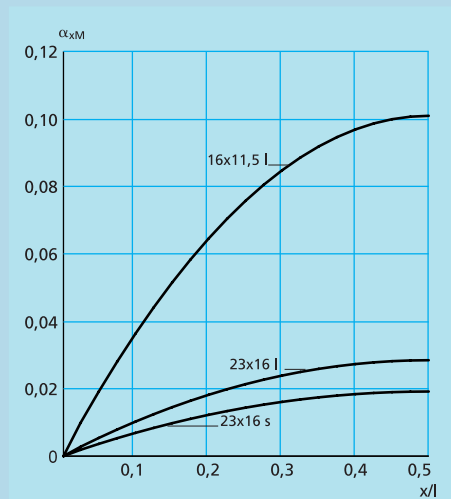
(with  $e$  = lever arm in m,  $F$  in kN,  $l$  in m)

e.g. beam 46x32 I;  $l = 10$  m

$F = 7$  kN at  $x = 3,5$  m,  $e = 2$  m

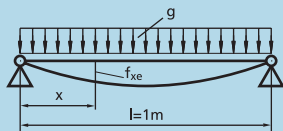
$$\Rightarrow x/l = 0,35 \text{ and } \alpha_{xM} = 0,0015$$

$$\alpha_x = 0,0015 \cdot 7 \cdot 2 \cdot 10 = 0,21^\circ$$



### Deflection under dead weight

Deflection ordinates  $f_{xe}$  in mm under dead weight as a function of point  $x$  for a unit span of  $l = 1$  m



Calculation of general cases:

$$f_x = f_{xe} \cdot l^4 \text{ [mm]}$$

(with  $l$  in m)

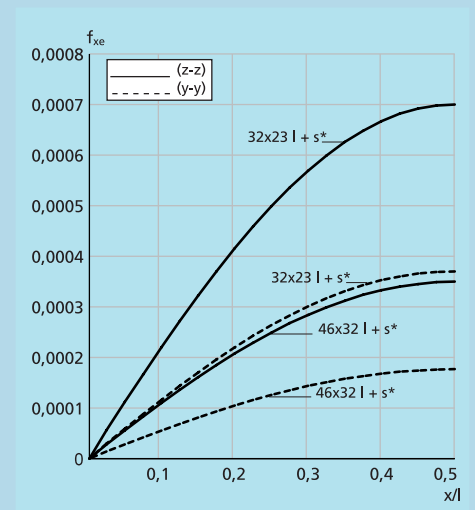
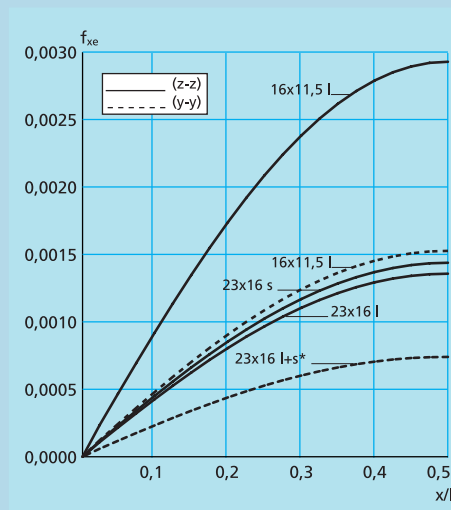
e.g. beam 23x16 I (z-z);

(bending about the weak axis)

$l = 8$  m,  $x = 3,2$  m

$$\Rightarrow x/l = 0,4 \text{ and } f_{xe} = 0,00128$$

$$f_x = 0,00128 \cdot 8^4 = 5,2 \text{ mm}$$



\* For these sections the ratio  $I/G$  is between variant  $l$  and  $s$  which is almost identical.

# Formulae for design

## Load carrying effect of attached steel parts

If steel parts such as guide rails or toothed racks are connected to the aluminium profiles this often results in a considerable increase of the stiffness/rigidity.

This is the case when the steel parts

- a) are the length of the beam
- b) are fixed to the aluminium beam with rigid means of connection.

The following calculation method applies:

This is to calculate an  $I^*$  which is based on the modulus of elasticity of aluminium as comparative modulus.

An additional assumption is that the axes through the centre of gravity of the aluminium profiles coincide with the respective centre lines (error 1,5 % max.) and that the ratio of the moduli of elasticity  $E_{st}/E_{Al}$  is 3.

$\Delta e$  which is the distance between the new axis through the centre of gravity and the (original) centre line is calculated on the basis of the following formulae:

$$\Delta e = \frac{3 \sum (A_{st,i} \cdot e_i)}{(A_{Al} + 3 \sum A_{st,i})} \text{ or}$$

$$\Delta e = \frac{\sum (A_i^* \cdot e_i)}{\sum A_i^*}$$

Therefore the relation

$$I^* = I_{Al} + 3 \sum I_{st} + 3 \sum (A_{st,i} \cdot (e_i - \Delta e)^2) + A_{Al} \cdot \Delta e^2$$

and in summary

$$I^* = \sum I_i^* + \sum (A_i^* \cdot e_i^2) - \Delta e^2 \cdot \sum A_i^*$$

applies to the higher moment of inertia. To calculate the above, please use the table below.

	$A_i$		$A_i^*$	$e_i \rightarrow$	$A_i^* \cdot e_i$	$e_i^2 \rightarrow$	$A_i^* \cdot e_i^2$	$I_i$		$I_i^*$
Al-beam		x 1 =		0	0	0	0		x 1 =	
Steel sec. 1		x 3 =							x 3 =	
Steel sec. 2		x 3 =							x 3 =	
Steel sec. 3		x 3 =							x 3 =	
Steel sec. 4		x 3 =							x 3 =	
	$\sum A_i^* =$		①	$\sum (A_i^* \cdot e_i) =$	②	$\sum (A_i^* \cdot e_i^2) =$	⑤		$I_i^* =$	⑥
				$\Delta e = ② / ① =$	③					
				$\sum A_i^* \cdot \Delta e^2 = ① \cdot ③^2 =$	④					
									$I^* = ⑤ + ⑥ - ④ =$	<input type="text"/>

Stresses are calculated on the basis of the following formulae:

for Al:  $\sigma = M / (I^* / e)$

for steel:  $\sigma = 3 M / (I^* / e)$

The shearing force per fixing means between steel and Al-beam is

$$T = \frac{3 Q S}{I^*} \cdot d,$$

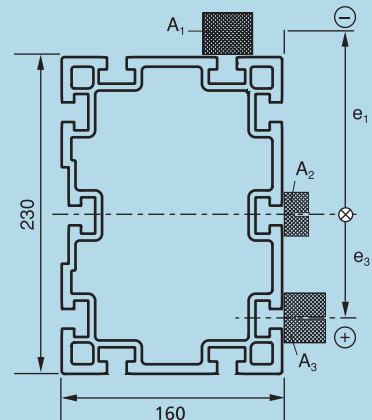
with  $S = A_{i,st} \cdot (e_i - \Delta e)$  and

$d$  = distance between the fixing means.

### Example:

#### Calculation of the values for NTS 23x16 I with bending about the Y-axis

	b [cm]	h [cm]	$A_i$ [cm <sup>2</sup> ]	$e_i$ [cm]	$I_i$ [cm <sup>4</sup> ]
Beam NTS 23x16 I	16	23	73,42	0	5128
Guide rail $A_1$	5	4	20	-13,5	26,67
Toothed rack $A_2$	3	5	15	0	31,25
Guide rail $A_3$	4	5	20	+7,5	41,67



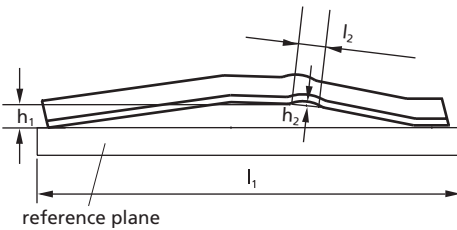
	$A_i$		$A_i^*$	$e_i \rightarrow$	$A_i^* \cdot e_i$	$e_i^2 \rightarrow$	$A_i^* \cdot e_i^2$	$I_i$		$I_i^*$
Al-beam	73,42	x 1 =	73,42	0	0	0	0	5128	x 1 =	5128
Steel sec. 1	20	x 3 =	60	-13,5	-810	182,25	10935	26,67	x 3 =	80,01
Steel sec. 2	15	x 3 =	45	0	0	0	0	31,25	x 3 =	93,75
Steel sec. 3	20	x 3 =	60	7,5	450	56,25	3375	41,67	x 3 =	125,01
Steel sec. 4		x 3 =							x 3 =	
	$\sum A_i^* =$		238,42 ①	$\sum (A_i^* \cdot e_i) =$	-360 ②	$\sum (A_i^* \cdot e_i^2) =$	14310 ⑤		$\sum I_i^* =$	5426,8 ⑥
				$\Delta e = ② / ① =$	-1,51 ③					
				$\sum A_i^* \cdot \Delta e^2 = ① \cdot ③^2 =$	543,6 ④					
									$I^* = ⑤ + ⑥ - ④ =$	<b>19193 cm<sup>4</sup></b> ( $\approx 3,7 \cdot I_{Al}$ )

# Tolerances

## Tolerance class P:

The tolerances are acc. to DIN 17615.3 or analogue values which are linearly extrapolated. Wall thicknesses are acc. to DIN 1748.4. A dimensional data sheet will be issued.

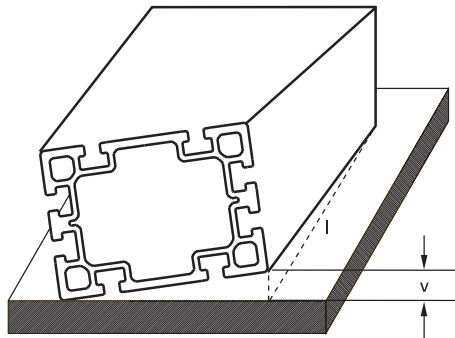
As to the straightness in the longitudinal direction the following applies:



Length $l_1$	2 m	4 m	6 m	8 m	10 m
max. $h_1$	1,3	2,2	3,0	4,0	5,0

Definition of short bends in length of  $l_2$   
 $h_2 \leq 0,3$  mm up to  $l_2 = 300$  mm und  
 $h_2 \leq 0,7$  mm up to  $l_2 = 1000$  mm

For twist  $v$  (referring to the wide surface of the profile) the following tolerances are valid as a function of  $l$ :



NTS ...	2 m	4 m	6 m	8 m	10 m
16x11,5	1,8	2,6	3,0	-	-
23x16	2,5	3,5	4,0	5,0	6,0
32x23	2,8	4,1	5,0	6,0	7,0
46x32	3,2	4,8	6,0	7,0	8,0

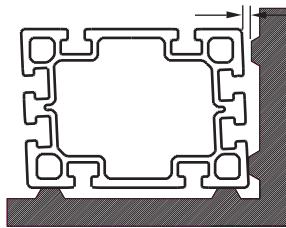
Tolerances on widths and heights:

NTS ...	Width	Height
16x11,5	160 ± 1,0	115 ± 0,6
23x16	230 ± 1,2	160 ± 1,0
32x23	320 ± 1,8	230 ± 1,2
46x32	460 ± 2,4	320 ± 1,8

Tighter tolerances can be kept on the parallelism (equidistance) of adjacent edges. The following tolerances apply as a function of  $l$ :

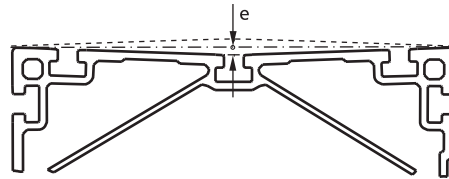
Dim.	2 m	4 m	6 m	8 m	10 m
115	0,3	0,35	0,4	-	-
160	0,35	0,4	0,45	0,5	0,6
230	0,4	0,5	0,6	0,7	0,8
320	0,5	0,6	0,8	1,0	1,2
460	0,7	0,8	1,0	1,2	1,4

As to corner areas the following tolerances on angularity  $w$  apply:



NTS ...	Deviation $w$ of the narrow surface
16x11,5	0,8
23x16	0,8
32x23	0,8
46x32	1,2

The tolerances on flatness  $e$  of the lateral surfaces (straightness transverse) are shown below:



Dimension	Flatness $e$
115	± 0,45
160	± 0,65
230	± 0,75
320	± 1,0
460	± 1,4

## Tolerance class S:

In general the tolerances indicated for tolerance class P apply. However, smaller tolerance values may be feasible in particular cases. A dimensional data sheet will be issued. The values indicated below are a guide:

Tolerance on straightness in the longitudinal direction:

Length $l_1$	6 m	10 m
max. $h_1$	up to 1 mm	up to 2 mm

Tolerance on twist

NTS ...	2 m	4 m	6 m	8 m	10 m
16x11,5	0,3	0,4	0,5	0,6	0,7
23x16	0,4	0,55	0,7	0,85	1,0
32x23	0,6	0,8	1,0	1,25	1,5
46x32	0,9	1,15	1,4	1,7	2,0

Tolerance on parallelism (equidistance)

Dim.	2 m	4 m	6 m	8 m	10 m
115	0,2	0,2	0,2	-	-
160	0,2	0,2	0,2	0,25	0,3
230	0,2	0,25	0,3	0,35	0,4
320	0,25	0,3	0,4	0,5	0,6
460	0,35	0,4	0,5	0,6	0,7

Tolerance on angularity

NTS ...	Deviation $w$ of the narrow surface
16x11,5	0,2
23x16	0,3
32x23	0,4
46x32	0,6

Tolerance on flatness  $e$  of the lateral surface (straightness transverse)

Dim.	Flatness $e$
115	0,3
160	0,4
230	0,55
320	0,7
460	1,0

**It is not possible to have all minimum values at the same time. Please contact us in time to discuss your special requirements.**

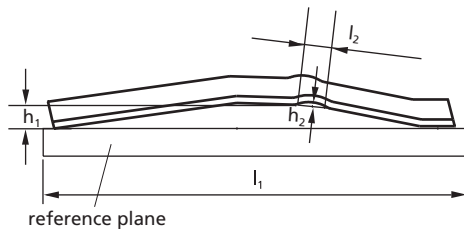
Where no unit is indicated values are in mm.

# Tolerances

## Tolerance class N:

In general the tolerances acc. to DIN 1748.4, "fine straightened" apply with regard to the dimensions of the profiles. No dimensional data sheet will be issued.

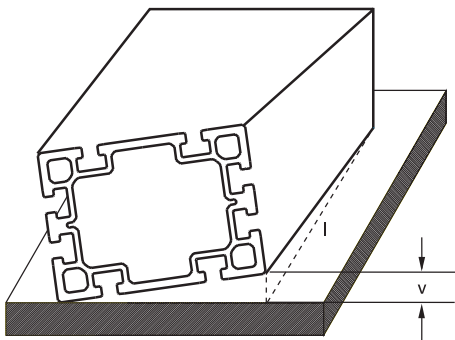
As to the straightness in the longitudinal direction the following applies:



Length $l_1$	2 m	4 m	6 m	8 m	10 m
max. $h_1$	2,0	3,5	5,0	7,0	9,0

Definition of short bends in length of  $l_2$   
 $h_2 \leq 0,3$  mm up to  $l_2 = 300$  mm and  
 $h_2 \leq 1,0$  mm up to  $l_2 = 1000$  mm

For twist  $v$  (referring to the wide surface of the profile) the following tolerances are valid as a function of  $l$ :



NTS ...	2 m	4 m	6 m	8 m	10 m
16x11,5	3,0	3,0	3,0	-	-
23x16	4,0	4,0	4,0	6,0	6,0
32x23	4,0	5,0	5,0	8,0	10,0
46x32	5,0	6,0	6,0	8,0	10,0

Tolerances on widths and heights:

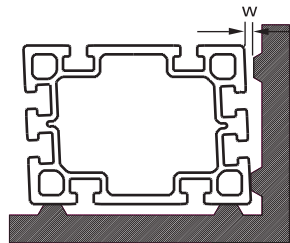
NTS ...	Width	Height
16x11,5	160± 1,5	115± 1,1
23x16	230± 1,9	160± 1,5
32x23	320± 3,0	230± 1,9
46x32	460± 3,5	320± 3,0

Where no unit is indicated values are in mm

Closer tolerances can be kept on the parallelism (equidistance) of adjacent edges. The following tolerances apply as a function of  $l$ :

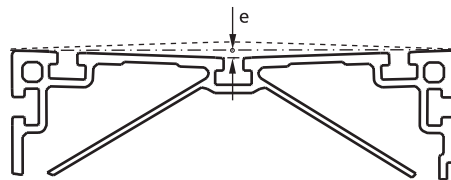
Dim.	2 m	4 m	6 m	8 m	10 m
115	0,4	0,4	0,5	-	-
160	0,5	0,6	0,7	0,8	0,9
230	0,7	0,8	0,9	1,0	1,2
320	0,9	1,0	1,2	1,3	1,6
460	1,1	1,3	1,5	1,8	2,1

As to the corner areas the following tolerances  $w$  on angularity apply:



NTS ...	Deviation $w$ of the narrow surface
16x11,5	0,9
23x16	1,3
32x23	1,6
46x32	1,9

The tolerances on flatness  $e$  of the lateral surfaces (straightness transvers) are shown below:



Dim.	Flatness $e$
115	±0,7
160	±0,9
230	±1,2
320	±1,8
460	±2,4

# Stock lengths/ Profiles cut to length

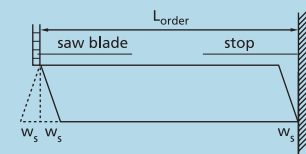
## Stock lengths

Profile 16x11,5 is available ex stock in lengths of 6 m; all other profiles in lengths of 6 m and 10 m. Other lengths upon request.

Tolerance on length: +200/-0 mm  
 Always subject to prior agreement.

## Profiles cut to length

The profiles are cut with a tolerance  $t_s$  which means that the length between the cut (first grip of sawing teeth) and the stop is within the range of this tolerance value.



Additionally the cutting angle  $w_s$  must be defined. Unless otherwise agreed, this angle is to be  $w_s = t_s/2$  (on the basis of the mean profile axis).

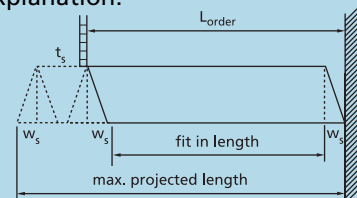
## Fixed lengths with plus tolerances

The values in mm for  $t_s$  are as follows:

NTS ...	up to 5 m	up to 10 m
16x11,5	6	8
23x16	6	8
32x23	8	10
46x32	8	10

**Note:** To be able to machine a "precise length  $L$ " (parallel at both ends) from a cut-to-length profile, the length to be ordered has to be increased by  $2w_s = t_s$ .

Explanation:



(On the basis of this definition the projected length of a profile can be max.  $L+t_s+3w_s$ .)

Length to be ordered:

$$L_{\text{order}} = L + t_s \dots \dots \dots + t_s - 0$$

Example: precise length  $L$  4800 mm; section 23x16 i.e.  $t_s = 6$  mm. This results in a length to be ordered of 4806 mm +6/-0.

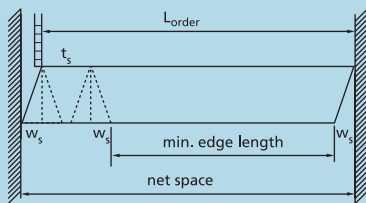


### Fixed lengths with minus tolerances

The values in mm for  $t_s$  are as follows:

NTS ...	up to 5 m	up to 10 m
16x11,5	4	6
23x16		
32x23	6	8
46x32		

Note: To obtain the fit in length (i.e. it must be possible to fit the cut-to-length profile between two parallel surfaces at a distance L) the length to be ordered must be reduced by  $w_s = t_s/2$  referring to the net space.  
Explanation:



(On the basis of this definition the length of the shortest edge of a profile can be  $L - t_s - 3w_s$ .)

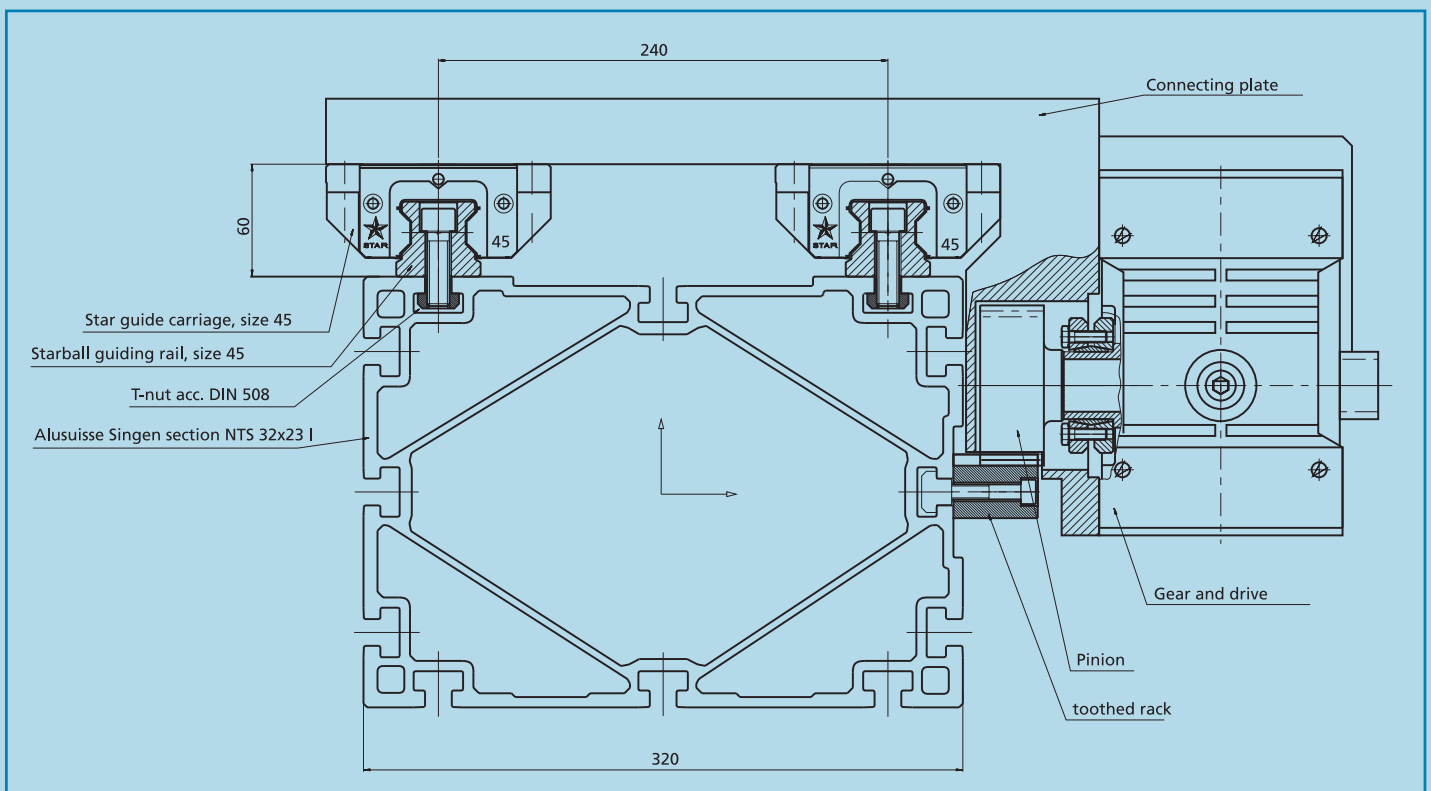
Length to be ordered:

$$L_{\text{order}} = L - t_s/2 \dots \dots \dots \begin{matrix} +0 \\ -t_s \end{matrix}$$



Example: Net space 4800 mm, section 23x16 results in  $t_s = 4$  mm and a length to be ordered of 4798 mm +0/-4.

**Upon special agreement, profiles can be supplied which are cut with tighter tolerances.**






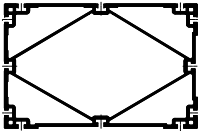
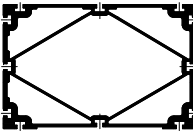




## Modified Delivery Terms for NTS Profiles

As of July 2007 the following delivery conditions apply for the NTS profiles: Profiles 41732, 41735, 41738 and 41741 are available from stock, in lengths up to 10 m. Profiles 41744, 41747 and 41750 are available upon request.

The three tolerance classes N, P, and S are replaced by the consistent tolerances listed below. ( They correspond to approx. the previous class "P" tolerance). A drawing is available upon request with the exact tolerance details.

	Designation Weight per meter	T O L E R A N C E S							Flatness (straightness transverse) wide side	Flatness (straightness transverse) small side	Angularity
		Height/ width	Parallelism small side	Parallelism wide side	Straightness including twist	Short bends in length	Flatness (straightness transverse) small side	Flatness (straightness transverse) wide side			
 41732	<b>NTS 16x11,5</b> W=13.5kg	115±0.8 160±1.1	0.5mm/ 10m	0.6mm/ 10m	6.0mm/ 10m	1.0mm/ 2000mm	0.4mm	0.6mm	0.8mm		
 41735	<b>NTS 23x16l</b> W=19.8kg	160±1.0 230±1.1	0.6mm/ 10m	0.9mm/ 10m	6.5mm/ 10m	1.0mm/ 2000mm	0.6mm	0.8mm	0.9mm		
 41738	<b>NTS 23x16s</b> W=29.7kg	160+1.1/-0.4 230±1.0	0.3mm/ 3000mm 0.6mm/ 10m	0.8mm/ 10m	7.0mm/ 10m	1.0mm/ 2000mm	0.6mm	0.7mm	0.6mm		
 41741	<b>NTS 32x23l</b> W=34.7kg	230±0.8 320±1.3	0.8mm/ 10m	1.0mm/ 10m	7.5mm/ 10m	1.2mm/ 2000mm	1.0mm	1.0mm	0.8mm		
 41744	<b>NTS 32x23s</b> W=46.1kg	230±1.2 320±1.8	1.0mm/ 10m	1.3mm/ 10m	8.0mm /10m	1.2mm/ 2000mm	0.8mm	1.2mm	1.0mm		
 41747	<b>NTS 46x32l</b> W=51.1kg	320±1.8 460±2.4	1.3mm/ 10m	1.5mm/ 10m	8.5mm/ 10m	1.5mm/ 2000mm	1.8mm	2.4mm	1.9mm		
 41750	<b>NTS 46x32s</b> W=66.8kg	320±1.8 460±2.4	1.3mm/ 10m	1.5mm/ 10m	9.0mm/ 10m	1.5mm/ 2000mm	1.2mm	1.6mm	1.5mm		

# The way to your own individual section

In many cases the question will be asked, whether or not it is an advantage to have your own individual section.

The advantages are: a section with optimum shape and weight, so that in the final analysis there are cost saving advantages as well as distinctive design features making the section exclusive.

Necessary concessions: Capital expenditure on a product whose market possibilities cannot be specifically assessed, die costs, minimum quantities, development decisions taken in haste, uncertainty regarding the final shape of the profile.

However these entrepreneurial decisions must be taken. At this stage the argument may be, that when compared with steel, die costs and minimum quantities are not nearly so high for aluminium extrusions and for these reasons many companies have already taken the step of having their own individual section.

The NTS beam system offers the designer alternatives in different situations:

For machines and frameworks that are produced and sold in small quantities.

When it is possible to adapt an existing system to use NTS beams, one saves die costs with the advantages of an individual section.

By starting a new development with NTS beams and changing later to an individual shape, the entrance risk into the market is minimised and the design can be proved.

## Alloys

Based on its excellent combination of characteristics alloy AlMgSi0,5 (6060,6063) was chosen for the NTS beam system. Practically all extrusion alloys are heat-treatable alloys. They extrude well, but attain their strength only by heat-treatment which includes quenching.

According to the alloy, quenching must be done with water or with air.

As a rule mechanical engineering requires tight tolerances on the shape and small residual stresses.

Therefore air-quenched alloys have the advantage.

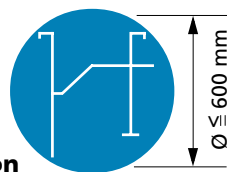
Besides AlMgSi0,5 (6060,6063) there is also alloy AlZn4,5Mg1 (7020), which is air-quenchable. The high strength of this alloy would be an additional incentive for many applications. However, it has a higher flow stress, which means it requires larger wall thicknesses, simpler profile shapes and is more expensive. Therefore it is only considered for special cases.

When new sections are being developed, the conclusion is, that AlMgSi0,5 (6060,6063) should be the first alloy to be considered.

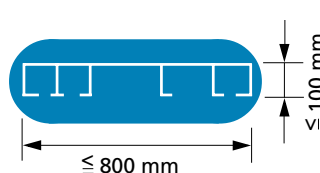
## Dimensions

For maximum cross-sectional dimensions the following diagrams illustrate the general limits. These limits are within our manufacturing capabilities. However any borderline section should be discussed at the planning stage with the application engineers at Alusuisse Singen.

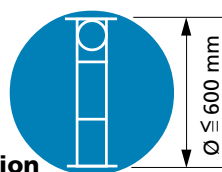
### Solid section



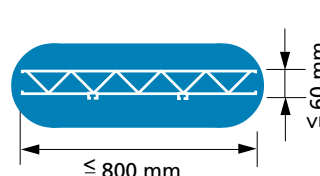
### Solid section



### Hollow section



### Hollow section



## Minimum wall thicknesses and weights

There are also factors governing the minimum wall thicknesses and minimum weights, which should not be overlooked.

For AlMgSi0,5 (6060,6063) the following applies:

Circumsr. circle $\varnothing$ [mm]	min. weight [kg/m]	min. wall thickness [mm]
< 40	0,15	1,2
up to 100	0,35	1,8
up to 160	0,7	2,0
up to 200	1,3	2,5
up to 320	3,5	3,0
up to 400	6,0	4,0
> 400	On request	

## Tolerances:

DIN 1748/4 is applied in most cases, however, depending on the application DIN 17615/3 can be a basis for design and production. The tolerances stated in this publication can not be taken as a general guideline. For symmetrical sections, which are manufactured in large quantities, relatively small tolerances can be held.

Please feel free to discuss your ideas and plans with us at the planning stage.

**The above explanations are valid exclusively for applications similar to the NTS beam system. Alusuisse Singen supplies profiles in a comprehensive range of sizes, alloys and mechanical strength. Data for these possibilities are available on request through brochures or by direct contact.**



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